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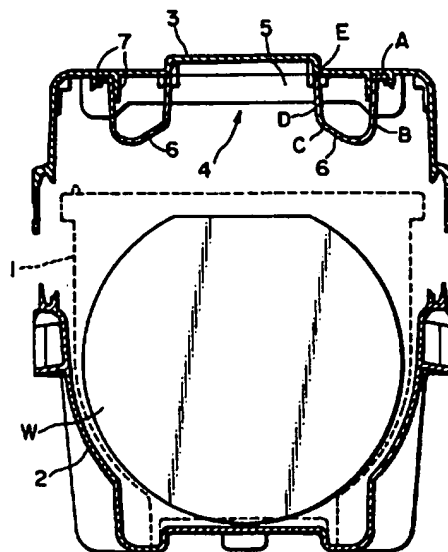
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(54) Wafer carrier with cushioning means

(57) A carrier for wafer materials W such as semiconductor silicon wafers comprises a box bottom 2 for holding the wafers, a cover 3 to be mounted on and engaged with the box bottom 2 and a wafer cushioning means mounted on the lower surface of the cover which serves to press down on the wafers with elastic resilience to prevent jouncing of the wafers during transportation. The wafer cushioning means consists of a rectangular frame and a pair of cushioning shoes each in the form of a toothed comb connected to and extending downwardly from one of the oppositely facing sides of the rectangular frame with the comb teeth bent inwardly to extend in the horizontal direction, then upwardly to reach the lower surface of the cover 3 or the frame. In this way, the cushioning shoe is supported at two positions to give enhanced resistance against elastic fatigue.

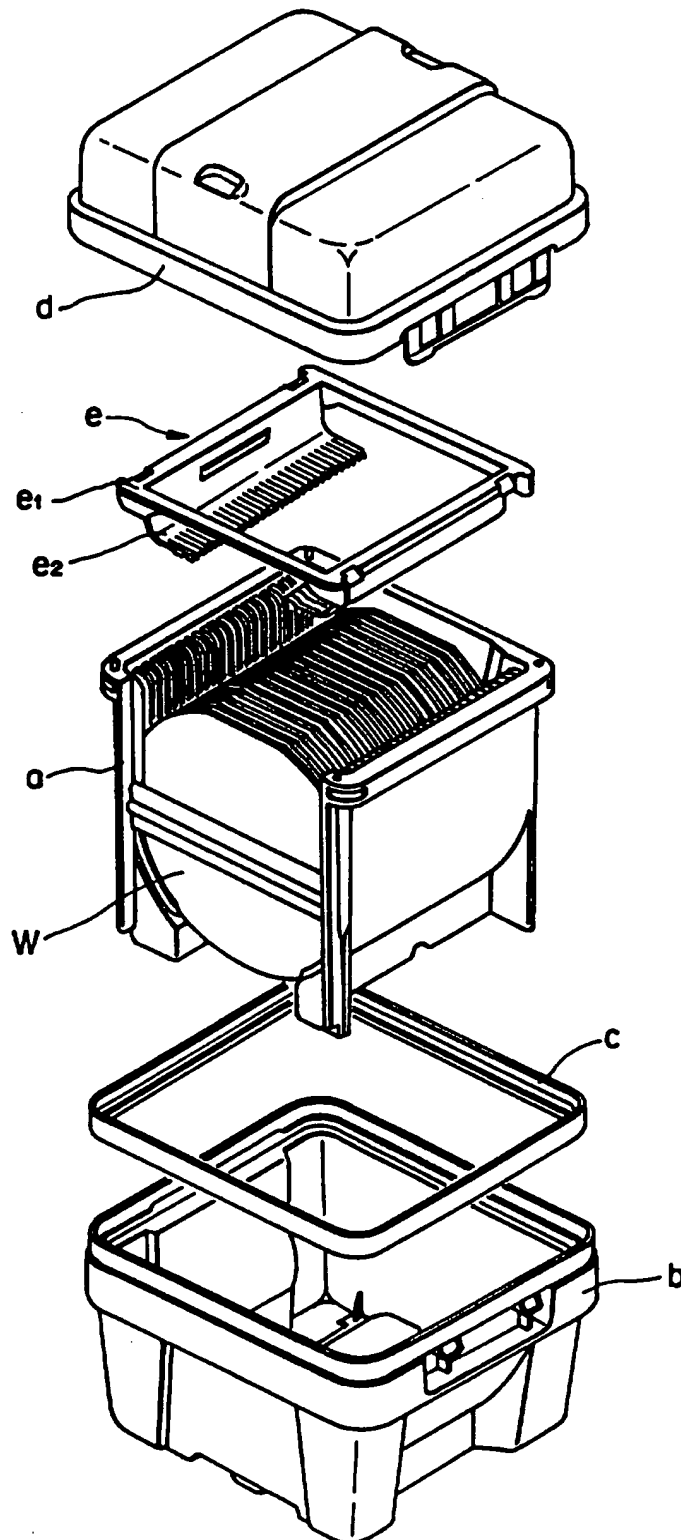
FIG. 5a



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FIG. 1



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FIG. 2

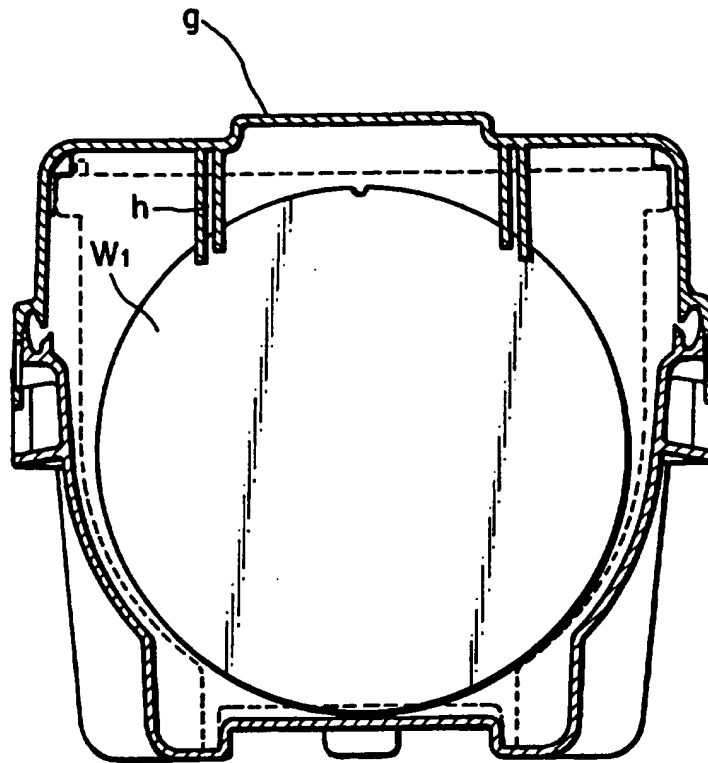
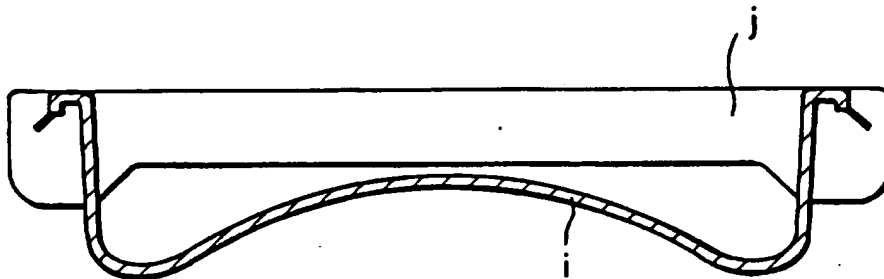


FIG. 3



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FIG. 4a

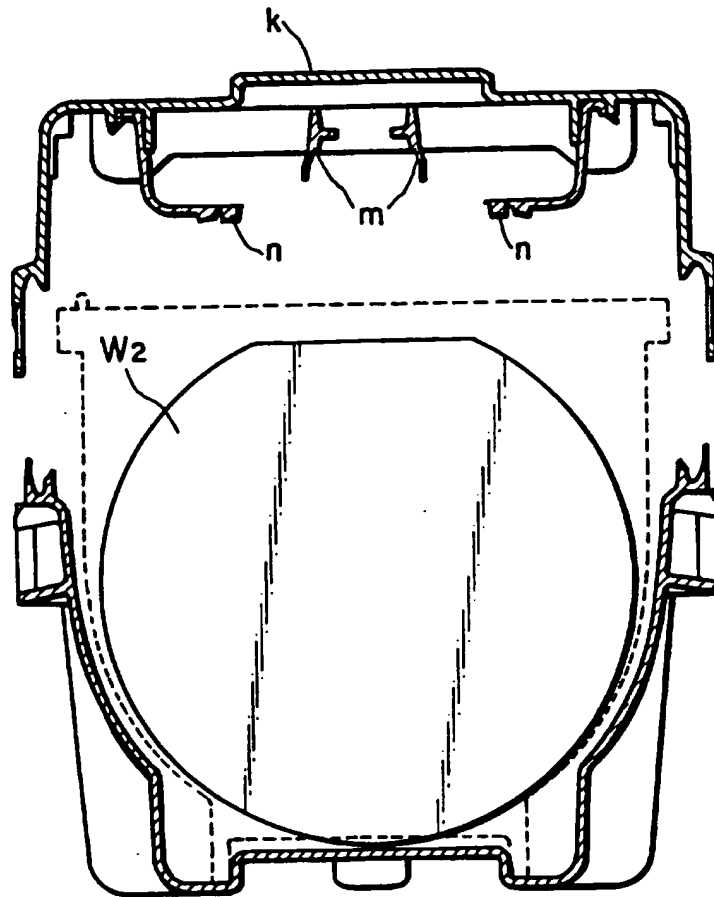
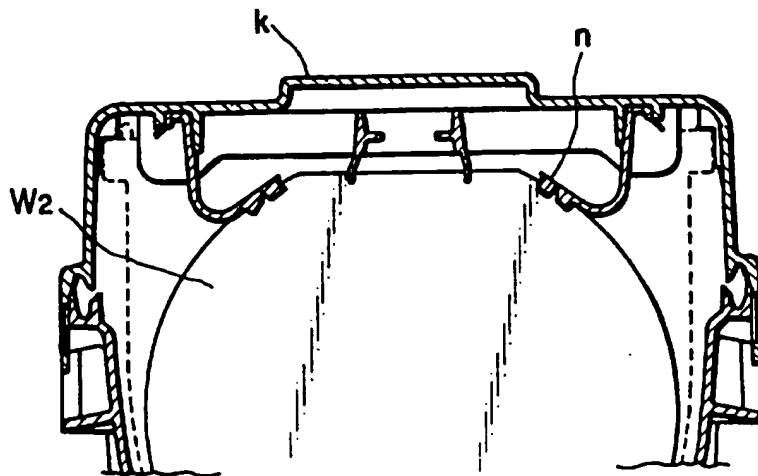


FIG. 4b



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FIG. 5a

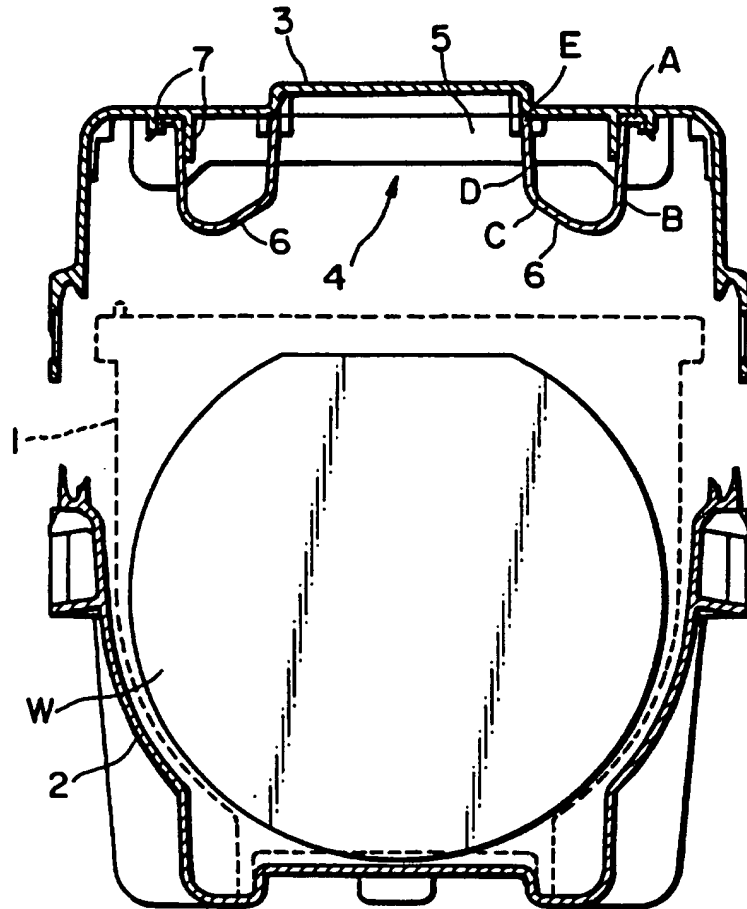
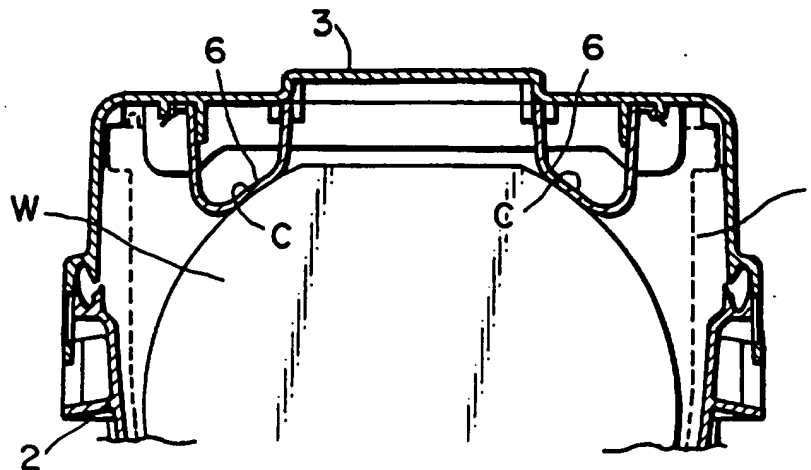


FIG. 5b



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FIG. 5c

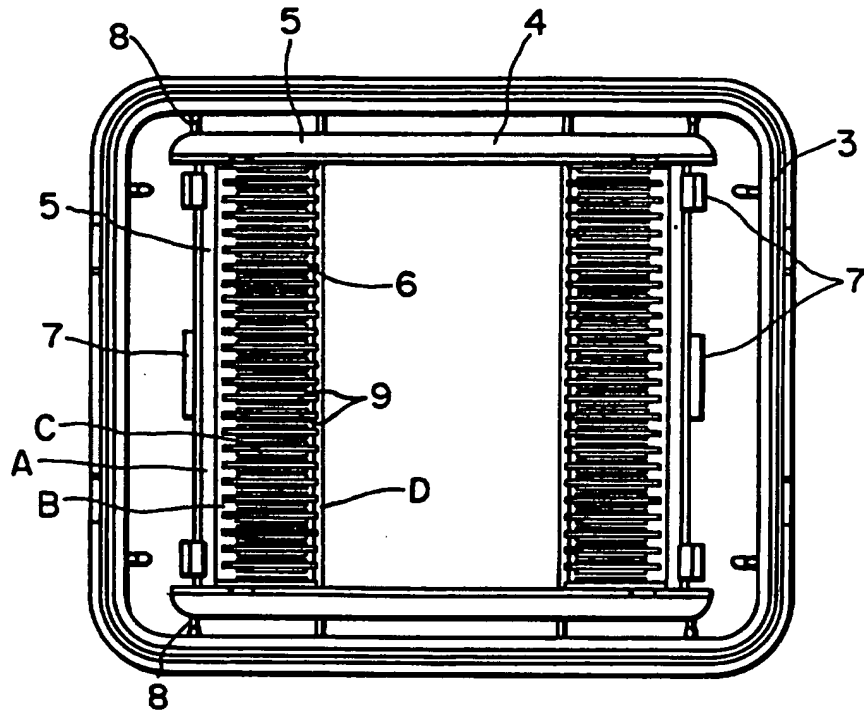
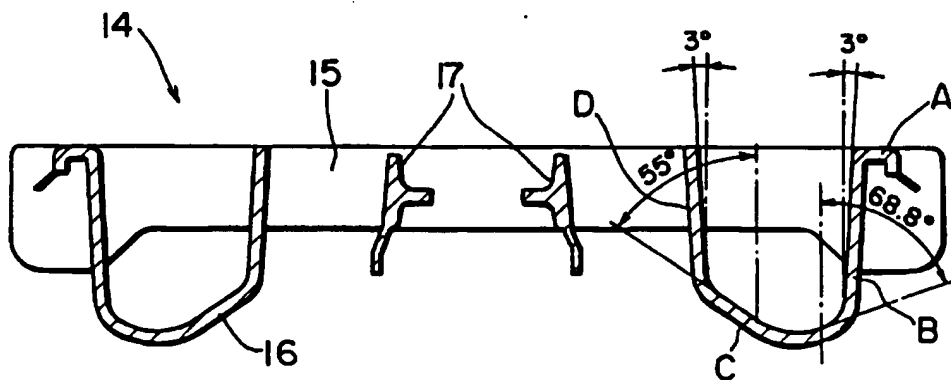


FIG. 6



WAFER CARRIER WITH CUSHIONING MEANS

The present invention relates to a wafer carrier for holding a plural number of wafer materials such as semiconductor silicon wafers provided with a wafer cushioning means which serves to secure the wafers contained in the wafer carrier by pressing with elastic resilience to prevent jouncing of the wafers during transportation and handling of the wafer carrier.

10

Along with the progress in the semiconductor industry, it is a very common procedure that a large number of semiconductor silicon wafers are handled, stored or transported. In order to prevent the wafers from mechanical damages and contamination during the procedures, it is usual that a plural number of wafers are contained in a wafer carrier consisting of a carrier bottom into which a wafer cassette holding the wafers standing in an upright disposition by keeping a narrow gap spaces each from the adjacent ones is put and a cover is mounted on and engaged with the carrier bottom to ensure a dust-free condition of the wafers.

With an object to prevent the wafers from jouncing in the wafer carrier during transportation and handling, it is conventional that the cover of the wafer carrier is provided on the lower surface thereof with a wafer cushioning means which serves to secure the wafers contained in the wafer carrier by pressing with elastic resilience in order to prevent jouncing of the wafers. Figure 1 of the accompanying drawing illustrates a perspective view of a typical wafer carrier in the prior art disassembled into parts including a wafer cassette a holding a plural number of wafers W each in an upright disposition as inserted into the grooves on the side walls of the wafer cassette a, a box bottom b into which the wafer cassette a is inserted, a gasket c which ensures airtightness between the wafer cassette a and the box bottom b when the cassette a is inserted into the bottom b, a cover d to be mounted on the box bottom b after insertion

of the wafer cassette a into the bottom b and a wafer cushion e consisting of a rectangular frame e1 and a pair of shoes e2 in the form of a toothed comb, each shoe e2 being engaged to the frame e1 along one of the oppositely facing sides of the rectangular frame e1 and extending horizontally. The wafer cushion e is usually connected to the cover d on the lower surface thereof. When the wafer cassette a holding the wafers W is inserted into the carrier bottom b and the cover d provided with the wafer cushion e on the lower surface is mounted on the box bottom b to be engaged therewith, the comb teeth of the shoes e2 having elastic resilience come into contact with the upper peripheries of the wafers W with a moderate contacting pressure so that the wafers W are pressed down and secured at the position to be prevented from jouncing.

Figure 2 illustrates a vertical cross-sectional view of another wafer carrier of the prior art comprising a cover g provided with a pair of dual cushioning fins h extending downwardly to be in contact with the wafers W1 which are pressed down by the downwardly extending cushioning fins h. Figure 3 illustrates a further alternative cover j in the prior art which is provided on the lower surface with an arched leaf spring i which comes into contact with and resiliently presses down the wafers when the cover j is mounted on the box bottom containing the wafer cassette holding the wafers. In the prior art wafer carrier illustrated in Figures 4a and 4b, the cover k is provided on the lower surface with a pair of downwardly extending wafer checks m along the centre line of the cover k and a pair of elastic cushioning shoes n each connected to the cover k along one of the oppositely facing sides. When the cover k is mounted on the box bottom as is illustrated in Figure 4b containing wafers W2 each having an orientation flat directed upwardly, the wafer checks m are engaged with the wafers W2 at the centre of the orientation flat while the shoes n come into contact with and resiliently press down the wafers W2 at the shoulders with the shoe end bent upwardly.

These prior art wafer cushioning means illustrated in the figures each have respective disadvantages. For example, the cushions e2, h, m and n illustrated in Figures 1, 2, 4a and 4b, respectively, are each an elastic cantilevered member supported only at one end by the cover or the frame to be elastically bent when in contact with the wafers so that they are liable to creeping deformation in the bent portion due to elastic fatigue. This problem is particularly important when the wafer carrier holding wafers is transported after storage for a long period of time because of the decrease in the elastic resilience by which the wafers are pressed down to cause jouncing, movement, rubbing and the like of the wafers during transportation resulting in eventual contamination due to the dust particles produced by rubbing between wafers or between wafers and the wafer cushioning means.

The model illustration in Figure 3, on the other hand, is relatively safe from the problem of elastic fatigue in the wafer cushioning means because the arched leaf spring member i is not a cantilever but is fixed at both ends to the cover j. A disadvantage in this model of the wafer cushioning means is that the arched leaf spring member i which covers the major portion of the wafers below the wafer cushioning means, greatly decreases the visibility of the wafers contained in the wafer carrier to disturb counting of the number of the wafers badly affecting the working efficiency.

Further, it must be taken into consideration that the wafer cushioning means should exhibit a holding efficiency of wafers irrespective of the type of the benchmark for the crystallographic orientation of the wafers which can be an orientation notch as is illustrated by W1 in Figure 2 or an orientation flat as is illustration by W2 in Figures 4a and 4b. Namely, a type of the wafer cushioning means effective for the wafers W1 with an orientation notch is not always effective for the wafers W2 with an orientation flat or

vice versa to cause jouncing of the wafers or generation of dust particles.

The present invention accordingly has an object to provide
5 a new and improved wafer carrier provided with a wafer cushioning means which is free from the above described problems and disadvantages unavoidable with the wafer cushioning means in the prior art wafer carriers.

10 Thus, the wafer carrier of the invention comprises an assembly of:

- 15 (a) a bottom portion adapted to hold the said plural number of wafer materials;
- (b) a cover portion adapted to be mounted on the bottom portion; and
- 20 (c) a wafer cushioning means adapted to be located between the cover portion and the bottom portion when the carrier is assembled and comprising at least a pair of laterally spaced resilient cushioning shoes, each in the form of a toothed comb extending downwardly, each of the comb teeth
25 being bent laterally and then upwardly to a substantially "U"-shaped configuration with the end of the tooth abutting or connecting to the cushioning means or the cover portion when the carrier is assembled.

30

Preferably, the bottom portion is box-shaped.

The wafer cushioning means may be adapted to be mounted on the lower surface of the cover portion.

35

Preferably, the cushioning means comprises a rectangular frame. The cushioning shoes may be connected to laterally opposite sides of the rectangular frame with the comb teeth

arranged along the direction of the frame side to which the cushioning shoe is connected.

The upwardly directed end of each tooth is connected to the rectangular frame. Alternatively, the upwardly directed end of each tooth may reach the lower surface of the cover portion.

The present invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a conventional wafer carrier with a wafer cushioning means disassembled into parts;

Figures 2, 3, 4a and 4b are each an illustration of the wafer cushioning means in a conventional wafer carrier of different types by a vertical cross-sectional view;

Figures 5a and 5b are each an illustration of the wafer cushioning means in the inventive wafer carrier by a vertical cross-sectional view and Figure 5c is a plan view of the lower surface of the cover in the inventive wafer carrier with the wafer cushioning means mounted thereon;

Figure 6 is a vertical cross-sectional view of the wafer cushioning means in the inventive wafer carrier to illustrate a particular design.

In the following, the wafer cushioning means used in the inventive wafer carrier is described in detail by making reference to the accompanying drawing.

30

Figure 5a is a vertical cross-sectional view of the inventive wafer carrier with a wafer cushioning means 4 before mounting of the cover 3 on to the box bottom 2. The wafer cassette 1 holding a plural number of wafers W in an upright disposition is inserted into the box bottom 2 and then the cover 3 provided with a wafer cushioning means 4 is mounted on the box bottom 2 and air-tightly engaged therewith along the peripheries. The wafer cushioning means 4 is an assembled body consisting of a rectangular

frame 5 (see Figure 5c) connected to the cover 3 as being engaged at the receptacles 7 of cover 3 in a demountable fashion and a symmetric pair of cushioning shoes 6 having elastic resilience. The cushioning shoe 6 has an elongated configuration of a toothed comb having comb teeth arranged along the longitudinal direction. Each of the cushioning shoes 6 is connected to the frame 5 at the untoothed base A along one of the oppositely facing sides of the frame 5. Each of the comb teeth B extending downwardly from the untoothed base A is first bent inwardly to form a U-shaped turning C and then bent upwardly along the portion D to reach the lower surface of the cover 3 at the tooth end E.

When the cover 3 provided with the wafer cushioning means 4 on the lower surface thereof is mounted on the box bottom 2 holding wafers W as is illustrated in Figure 5b, the box bottom 2 and the cover 3 are engaged together at the latches 8 while each of the wafers W on the wafer cassette 1 is inserted at the shoulder portions into the gap space between two fins 9 (Figure 5c) on the U-turning portions C of the adjacent comb teeth of the cushioning shoe 6. It is alternative that, instead of insertion of the wafer W into the gap space between the flanged fins 9 of the adjacent comb teeth, each of the comb teeth is provided with a slit into which the wafer W is inserted to be secured at the position.

Since the end E of each comb tooth of the cushioning shoes 6 reaches the lower surface of the cover 3, the cushioning shoe 6 is held not by cantilever support but is double-supported at the untoothed base position A and the tooth ends E so that the wafer W is downwardly pressed and led to the properly position in the groove formed in the wafer cassette 1 reliably even with a moderate pressure of the wafer cushioning means 4 when the cover 3 is mounted on the box bottom 2. As a consequence of the double-supporting of the cushioning shoes 6 at the untoothed base A and at the tooth ends E of the comb teeth reaching the lower surface of the cover 3, an unexpected advantage is obtained that,

if not to mention the increased reliableness of wafer holding, the stress in the comb teeth is divided on to the untoothed base A and the tooth ends E so that the cushioning shoes 6 are exempted from the problem of elastic fatigue which otherwise is unavoidable due to concentration of the stress to the untoothed base A.

Figure 6 is an illustration of a particularly preferable design of the wafer cushioning means 14 by a vertical cross-sectional view with indication of the angles which the respective parts of the cushioning shoes 16 make with the vertical direction. The cushioning shoe 16 connected to the rectangular frame 15 at the untoothed base A first extends downwardly with an inward inclination of the toothed part B making an angle of 2 to 5° or, typically, 3° with the vertical direction followed by inward bending to make a U-turning along the part C rising by making an angle of 50 to 70° or, typically, 55° and finally by upward bending so that the rising part D makes an angle of 2 to 5° or, typically, 3°. When this specific embodiment is followed, the thickness of the cushioning shoes 16 can be as small as 0.5 to 3.0 mm though dependent on the particular elastic material forming the cushioning shoes 16.

25

It is optional, as is illustrated in Figure 6, that, besides the above described cushioning shoes 16, the cover of the wafer carrier is provided on the lower surface thereof with a symmetrical pair of wafer checks 17 similar to the wafer checks m shown in Figures 4a and 4b so that the reliability of wafer holding can be enhanced when the wafer has an orientation flat as is the case in the wafer W2 shown in Figures 4a and 4b.

35 While, in the above described embodiment of the invention, each of the tooth ends E reaching the lower surface of the cover 3 is not engaged with the cover 3 but just in contact therewith, it is optional that the tooth end E is connected to the frame 5 by engagement with a suitable receptacle

provided thereon in a similar manner to the untoothed base A. This modification is effective when the lower surface of the cover is not flat having projections or cavities so that not all of the comb teeth having a uniform length can just reach the lower surface of the cover. If necessary, the rectangular frame of the cushioning means is provided integrally with inside props, which run in the direction parallel to the frame sides to which the untoothed base A of the cushioning shoes is connected, and the tooth ends E of the cushioning shoes 6 are engaged thereto.

The materials forming the respective parts of the inventive wafer carrier are not particularly limitative but can be selected from conventional polymeric materials including thermoplastic resins such as polyolefins, eg polyethylene and polypropylene, ABS resins, polystyrenes, polycarbonates, poly(butylene terephthalates) and the like as well as thermoplastic elastomers such as polyester-based ones, polyolefin-based ones, polystyrene-based ones and the like. Though not particularly limitative, at least the cover of the wafer carrier should be formed from a transparent polymeric material in order to ensure visibility of the wafers contained within the wafer carrier. It is important that the wafer cushioning means or, in particular, the cushioning shoes are shaped from a polymeric material capable of exhibiting good elastic resilience without the problem of elastic fatigue.

CLAIMS:

1. A wafer carrier for holding a plural number of wafer materials comprising an assembly of:
 - 5 (a) a bottom portion adapted to hold the said plural number of wafer materials;
 - 10 (b) a cover portion adapted to be mounted on the bottom portion; and
 - 15 (c) a wafer cushioning means adapted to be located between the cover portion and the bottom portion when the carrier is assembled and comprising at least a pair of laterally spaced resilient cushioning shoes, each in the form of a toothed comb extending downwardly, each of the comb teeth being bent laterally and then upwardly to a substantially "U"-shaped configuration with the end of the tooth abutting or connecting to the cushioning means or the cover portion when the carrier is assembled.
- 20 2. A wafer carrier according to claim 1 in which the bottom portion is box-shaped.
- 25 3. A wafer carrier according to claim 1 or claim 2 in which the wafer cushioning means is adapted to be mounted on the lower surface of the cover portion.
- 30 4. A wafer carrier according to any preceding claim in which the cushioning means comprises a rectangular frame.
- 35 5. A wafer carrier according to claim 4 in which the cushioning shoes are connected to laterally opposite sides of the rectangular frame.

6. A wafer carrier according to claim 5 in which the comb teeth are arranged along the direction of the frame side to which the cushioning shoe is connected.
- 5 7. A wafer carrier according to claim 5 or claim 6 in which the upwardly directed end of each tooth is connected to the rectangular frame.
- 10 8. A wafer carrier according to any preceding claim in which the upwardly directed end of each tooth reaches the lower surface of the cover portion.
- 15 9. A wafer carrier substantially as described herein with reference to Figures 5 and 6 of the accompanying drawings.



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Claims searched: All

Examiner: Mr. G. Nicholls
Date of search: 19 December 1995

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.N): B8P (PE2C PE2D PE2G)

Int Cl (Ed.6): B65D 25/10 85/30 85/48 85/57

Other: ONLINE:WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	US 4718549 (RISOTTI) Note rib arrangements 20,21	
A	US 4557382 (JOHNSON) Note comb-like members 94,96	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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